

# BCS LEVEL 5 DIPLOMA IN IT SMART SYSTEMS

## SYLLABUS

# CONTENTS

- 3. Introduction
- 4. Qualification Suitability and Overview
- 5. SFIA Levels
- 6. Learning Outcomes
- 7. Syllabus
- 18. Examination Format
- 18. Question Weighting
- 19. Recommended Reading
- 21. Document Change History



# Introduction

## Level 5 Diploma in IT

The second stage within the BCS three-stage Higher Education Qualification programme, the Level 5 Diploma enables candidates who have already achieved the Level 4 Certificate in IT to progress to higher levels of knowledge and competency.

This internationally-recognised qualification introduces you to the business-related aspects of the IT industry, developing your technological expertise while also considering the potential challenges of the day-to-day running of an organisation, such as legal obligations and intellectual property.

Our modules have been created in-line with the latest developments in the industry, giving you a competitive edge in the IT job market. You will have the opportunity to learn about object-oriented programming, user experience, systems analysis and design, as well as to build upon knowledge and skills developed during the Level 4 Certificate.

To successfully achieve the qualification, candidates need to complete:

- One core module
- Three optional modules
- One Professional Project in IT

Candidates who wish to progress onto the next stage will need to complete the Project at end of the Level 6 Professional Graduate Diploma in IT.

## Smart Systems Optional Module

The Smart Systems module is an optional module that forms part of the Level 5 Diploma in IT – the second stage within the BCS three-stage Higher Education Qualification programme.

Candidates will be introduced to core concepts such as the fundamentals of artificial intelligence and pervasive computing, enabling technologies such as mobile and cloud computing, the application of smart systems, the impacts and challenges of using Smart Systems and Cyber Physical Systems security.

# Qualification Suitability and Overview

Candidates must have achieved the Certificate in IT or have an appropriate exemption to be entered for the Diploma in IT. Candidates can study for this diploma by attending a training course provided by a BCS accredited Training Provider or through self-study, although it is strongly recommended that all candidates register with an approved centre. Studying with an approved centre will deliver significant benefits.

Candidates are required to become a member of BCS, The Chartered Institute for IT, to sit and be awarded the qualifications. Candidates may apply for a four-year student membership that will support them throughout their studies.

The Level 5 Diploma is suitable for professionals wishing to gain a formal IT qualification, and this module may be particularly relevant for candidates interested in career opportunities such as systems and urban engineering, industrial strategy, or consulting.

<b>Total Qualification Time</b>	<b>Guided Learning Hours</b>	<b>Assessment Time</b>
<b>1086 hours</b>	<b>225 hours</b>	<b>2 hours</b>

# SFIA Levels

This module provides candidates with the level of knowledge highlighted within the table, enabling candidates to develop the skills to operate successfully at the levels of responsibility indicated.

Level	Levels of Knowledge	Levels of Skill and Responsibility (SFIA)
K7		Set strategy, inspire and mobilise
K6	Evaluate	Initiate and influence
K5	Synthesise	Ensure and advise
K4	Analyse	Enable
K3	Apply	Apply
K2	Understand	Assist
K1	Remember	Follow

## SFIA Plus

This syllabus has been linked to the SFIA knowledge skills and behaviours required at Level 5.

## INAN3

Undertakes analytical activities and delivers analysis outputs, in accordance with customer needs and conforming to agreed standards.

## ICPM3

Coordinates content management processes to meet the needs of users, including those with disabilities. Uses content publishing systems to manage published content across different channels. Takes into account any legal issues related to publishing, including that associated copyright concerns are adequately managed.

## SCTY4

Explains the purpose of and provides advice and guidance on the application and operation of elementary physical, procedural and technical security controls. Performs security risk, vulnerability assessments, and business impact analysis for medium complexity information systems. Investigates suspected attacks and manages security incidents. Uses forensics where appropriate.

Further detail regarding the SFIA Levels can be found at [www.bcs.org/levels](http://www.bcs.org/levels).

# Learning Outcomes

Upon completion of this module, candidates will be able to:

- Show an understanding of Smart Systems, their implementation and applications.
- Interpret and explain the impact of Smart Systems, ethical, legal, social, environmental implications.
- Explain concepts used in Smart Systems and associated architectures.
- Explain the major Smart Systems application areas and techniques used within them.
- Discuss examples of Smart Systems used in real life situations.

# Syllabus

## 1. Core concepts

### Learners will be able to:

**1.1** Define and explain the purpose of Smart Systems.

#### Indicative content

- a. The background and historical perspective of the Smart Systems domain
- b. Smart Services
- c. Smart Industry
- d. Smart Manufacturing, etc.

#### Guidance

Smart Systems are the next generation of computing and information systems that use a number of enabling technologies to provide real-time networked information. The term 'Smart' has given rise to a number of areas of application and candidates are expected to gain knowledge of these areas and to be able to define Smart systems and demonstrate an understanding of their purpose, their background, and evolution.

---

**1.2** Describe and explain the principles and fundamentals of Artificial Intelligence (AI).

#### Indicative content

- a. Historical background, principles and fundamentals of AI
- b. Knowledge of the characteristics of AI
- c. Different levels of AI
- d. Aspects of human intelligence used to characterise intelligent knowledge-based systems
- e. Potential of AI
- f. Advantages and disadvantages of AI

#### Guidance

AI is a wide ranging interdisciplinary field which has roots in, and intersects with many other domains and plays an essential role in Smart Systems. Candidates should have the knowledge of AI, its background, current, future and potential use, and be able to discuss its role, purpose and contribution to Smart Systems.

### 1.3 Define and explain the role of Pervasive Computing.

#### Indicative content

- a. Key principles of Pervasive Computing and its purpose
- b. Advantages of pervasive computing
- c. Knowledge of its features, connectivity, productivity etc.
- d. Pervasive Computing and its application

#### Guidance

Pervasive Computing is a software engineering concept that allows computerised technology to be used by any device and format in any place. Candidates should have the knowledge of its different forms, how it is used and the key principles and be able to explain and discuss its role in Smart Systems.

---

### 1.4 Describe and explain the purpose of Cyber Physical Systems (CPS).

#### Indicative content

- a. Definition and explanation of the nature of Cyber Physical Systems
- b. Purpose of Cybersecurity with respect to these systems
- c. Security challenges
- d. Classification of the areas of security in CPSs

#### Guidance

CPSs introduce many cybersecurity challenges in smart systems and it is important to understand the purpose of cybersecurity with respect to Cyber Physical Systems. CPSs are being increasingly used and form the basis for Smart Systems development. Candidates should have the ability to define and explain the purpose of CPSs as well as identify and discuss examples of cybersecurity challenges instigated by their use in Smart Systems.



**1.5** Explain the Internet of Things (IoT).

**Indicative content**

- a. Definition and purpose of IoT
- b. Its role and applications in Smart Systems
- c. Advantages and disadvantages of IoT

**Guidance**

The IoT is an essential technology in Smart Systems; candidates should be able to define and discuss the purpose and role of the IoT using relevant examples. The IoT is an enabling technology for Smart Systems and candidates should be able to identify and evaluate any challenges with regard to this technology.

---

**1.6** Define and describe the purpose of Big Data (BD), Data Analytics (DA) and Data Mining (DM).

**Indicative content**

- a. Purpose of Big Data, Data Analytics and Data Mining and their application
- b. How they are used in Smart Systems
- c. Advantages and disadvantages of their use

**Guidance**

Big Data, Data Analytics and Data Mining are now widely used and candidates should be able to define and explain the purpose of BD, DA and DM, and how they are used globally for a variety of business purposes. They should also be able to identify and discuss any challenges of their use and role in Smart Systems.

## 2. Enabling Technologies

### Learners will be able to:

**2.1** Explain distributed systems.

#### Indicative content

- a. Definition and examples of distributed systems
- b. Purpose of distributed systems and their application

#### Guidance

Candidates should be able to define and give examples of distributed systems and demonstrate knowledge of their purpose and discuss advantages for their use.

---

**2.2** Describe mobile computing.

#### Indicative content

- a. Definition and role of mobile computing
- b. Applications of mobile computing
- c. Features of mobile computing and how it works

#### Guidance

Candidates should demonstrate an understanding of mobile computing and how it works, identify its features, types, and applications for its use.

---

**2.3** Explain cloud computing.

#### Indicative content

- a. Definition of Cloud Computing
- b. Purpose of Cloud Computing
- c. Types of cloud, cloud services and its infrastructure as a service
- d. Its role in Smart Systems
- e. Advantages, disadvantages and challenges

#### Guidance

Cloud Computing facilitates shared computing resources via servers over the internet and provides on-demand individual access to global computer system resources and services, anytime, anywhere. Candidates should have an understanding of Cloud Computing and its application and use. They should be able to identify its infrastructure as a service and evaluate the advantages and disadvantages of the technology as well as be able to discuss the ethical considerations of cloud technology and the implications for its use in Smart Systems.

## **2.4** Describe development methods and tools.

### **Indicative content**

- a. Sensors, sensor networks and actuators, e.g.:
  - i. Movement
  - ii. Acceleration
  - iii. Light
  - iv. Proximity
  - v. Audio
  - vi. Temperature
  - vii. Humidity
  - viii. Mechanical forces
  - ix. Wireless networks

### **Guidance**

Candidates should have an understanding of what sensors and actuators are, and be able to identify their differences, differentiating between the two. They should gain knowledge of how actuators and sensors work together as well as be able to explain the basic components of sensor networks and their role in wireless communication. They should also be able to identify different types of sensors.

---

## **2.5** Explain Near-field communication (NFC), Radio-frequency identification (RFID) and their purpose.

### **Indicative content**

- a. NFC and its purpose
- b. RFID, its purpose, how it works and its uses
- c. Security concerns with the technology
- d. Security measures

### **Guidance**

Candidates should be able to define NFC and RFID technologies and explain how they are used. They should be able to evaluate any concerns with the technologies.

---

## **2.6** Explain AI and Machine Learning (ML).

### **Indicative content**

- a. Role of AI in Smart Systems
- b. Description of ML and background to the technology
- c. General functions of ML and its uses in applications of Smart Systems
- d. Relationships with AI, Big Data and areas of application
- e. Knowledge of Neural Networks

### **Guidance**

Big Data has given rise to a new field of AI and that is Machine Learning. With the rise of Big Data, ML has emerged as one of the best problem-solving technologies. Candidates should demonstrate an awareness and understanding of ML, its relationship with AI and Big Data, its purpose, and its areas of application as well as how it is used in data analytics and smart systems.

---

## **2.7** Explain Blockchain and its purpose.

### **Indicative content**

- a. Definition, function and purpose of Blockchain Technology

### **Guidance**

Smart Systems rely on a number of enabling technologies for their development, implementation and use. Blockchain is one of these enabling technologies. Candidates should be able to define Blockchain and explain its purpose and consequently its role in Smart Systems. They should also be able to evaluate benefits of this technology and any challenges it might provoke.

## 3. Applications

### Learners will be able to:

**3.1** Explain smart homes.

#### Indicative content

- a. Smart homes and Smart home devices
  - b. Advantages, disadvantages and challenges of smart home devices
  - c. Components of smart home automation
- 

#### Guidance

Candidates should be able to define smart homes, the devices and components of smart home automation and have the ability to discuss the advantages and disadvantages of smart home devices and have an awareness of any challenges they might present.

**3.2** Explain smart appliances.

#### Indicative content

- a. Definition of smart appliances
  - b. Advantages and disadvantages of smart appliances and their application
  - c. Types of appliances
- 

#### Guidance

Candidates should be able to identify applications of smart appliances and demonstrate an understanding of what smart appliances are, and the advantages and disadvantages they have.

**3.3** Explain smart things.

#### Indicative content

- a. Smart things and their benefits
- b. Advantages and disadvantages of Smart things

#### Guidance

Candidates should demonstrate an understanding of smart things and the advantages and disadvantages of their development and use.

### **3.4** Explain healthcare applications.

#### **Indicative content**

- a. Smart health applications
- b. Types of applications
- c. Devices and components used in the development of smart health applications
- d. Challenges and risks in health applications

#### **Guidance**

Candidates should have the ability to identify a variety of smart health applications and areas for their use as well as evaluate the validity in their development and use. An awareness of any challenges and ethical implications for their development and use should be paramount.

---

### **3.5** Describe smart spaces.

#### **Indicative content**

- a. Description of smart spaces
- b. Identification of how smart spaces change the role of mobile devices
- c. Examples of smart spaces
- d. Security and privacy issues in smart space environments
- e. Enabling technologies for smart spaces

#### **Guidance**

An ability to describe and identify examples of smart spaces should be part of the learning. In smart spaces where devices constantly communicate with each other, issues of privacy and security tend to arise. Sensor networks are key to the creation of smart spaces, but they can also impose privacy and security issues, candidates should have an awareness of these issues in relation to smart spaces and how they might be prevented.

## 4. Impacts and Challenges

### Learners will be able to:

**4.1** Explain the ethical considerations.

#### Indicative content

- a. Social and environmental impact
- b. Privacy issues
- c. Design and development issues
- d. Energy consumption
- e. Resources
- f. Security issues
- g. Psychological wellbeing

#### Guidance

Due to the nature of Smart Systems, candidates should demonstrate an awareness of the ethical considerations in both the development and use of Smart Systems and their social and environmental impact. Candidates will discuss ethical issues that might arise using examples to support their discussions.

---

**4.2** Explain sustainability and economic impacts.

#### Indicative content

- a. How sustainable are smart systems?
- b. Economic impact due to the development and use of smart systems

#### Guidance

With the increase in consumption of energy, there is a need to conserve energy wherever possible. Candidates should be able to discuss, evaluate and have an awareness of the cost and sustainability implications for the development and use of Smart Systems.

---

**4.3** Explain privacy concerns.

#### Indicative content

- a. Identifying and explaining privacy concerns with the development and application of Smart Systems

#### Guidance

Smart systems devices have many advantages in industrial and social contexts, however, there are also a number of privacy issues that may arise with their development and use. Candidates should demonstrate an awareness of these privacy concerns and have the ability to identify these concerns and be mindful of possible strategies to address these issues.

**4.4** Explain security concerns.

### **Indicative content**

- a. Identifying security concerns in smart systems
- b. Their challenges and impact

### **Guidance**

The domain of Smart Systems has a number of security challenges, of which candidates are expected to have an awareness. They should have the ability to identify the security challenges with respect to the enabling technologies in the development of smart systems.

---

**4.5** Identify application standards.

### **Indicative content**

- a. Identifying and describing application standards
- b. Regulations and standards applicable to the design and development of Smart Systems

### **Guidance**

Candidates should have the ability to identify and describe any relevant application standards and why and how they are implemented.

---

**4.6** Describe legal aspects of application.

### **Indicative content**

- a. Identifying and describing legal aspects of application

### **Guidance**

Candidates should have knowledge of legal aspects of application as well as the ability to identify and describe relevant legal aspects of application.

## 5. Cyber Physical Systems Security

### Learners will be able to:

**5.1** Explain Operational Technology (OT) and Information Technology (IT) security.

#### Indicative content

- a. OT Security vs. IT security
- b. OT security's common uses
- c. Differences between OT and IT security
- d. Purpose of OT and IT security

#### Guidance

Candidates should demonstrate knowledge of OT and IT security and the differences between these system securities and their purpose.

---

**5.2** Describe the challenges of Operational Technology (OT) security.

#### Indicative content

- a. Challenges of OT security

#### Guidance

Candidates should be able to identify and discuss the challenges of OT security.

---

**5.3** Explain Cyber Physical Systems (CPS) risk management.

#### Indicative content

- a. Definition and explanation of the purpose of CPS security risk management
- b. Security concerns
- c. Elements of the risk management process

#### Guidance

The domain of Smart Systems has a number of security challenges, candidates should demonstrate an understanding of what CPS risk management is and be able to discuss its purpose and importance. The ability to identify and discuss elements of the risk management process in CPS is also required.

# Examination Format

This module is assessed through completion of an invigilated written exam.

<b>Type</b>	Four written questions from a choice of six, each with equal marks
<b>Duration</b>	Two hours
<b>Supervised</b>	Yes
<b>Open Book</b>	No (no materials can be taken into the examination room)
<b>Passmark</b>	10/25 (40%)
<b>Delivery</b>	Paper format only

Adjustments and/or additional time can be requested in line with the [BCS reasonable adjustments policy](#) for candidates with a disability or other special considerations.

## Question Weighting

Candidates will choose four questions from a choice of six. All questions are equally weighted and worth 25 marks.

# Recommended Reading

**Title:** Cyber physical systems security: Analysis, challenges and solutions

**Author:** Y. Ashibani and Q. Mahmoud

**Available at:** <<https://www.sciencedirect.com/science/article/pii/S0167404817300809?via%3Dihub>> [Accessed 9 July 2021]

**Title:** Artificial Intelligence: A Very Short Introduction

**Author:** M. Boden

**Publisher:** Oxford University Press

**Date:** 2018

**ISBN:** 978-0199602919

**Title:** Framework for Cyber-Physical Systems: Volume 1, Overview

**Author:** Cyber-Physical Systems Public Working Group

**Available at:** <<https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1500-201.pdf>> [Accessed 9 July 2021]

**Title:** Big Data: Using SMART Big Data, Analytics and Metrics To Make Better Decisions and Improve Performance

**Author:** B. Marr

**Publisher:** Wiley

**Date:** 2015

**ISBN:** 978-1118965832

**Title:** Handbook of Industry 4.0 and SMART Systems

**Author:** D. Pascual, P. Daponte and A. Kumar

**Publisher:** CRC Press

**Date:** 2019

**ISBN:** 978-1138316294

**Title:** Data Analytics and Big Data  
**Author:** S. Sedkaoui  
**Publisher:** ISTE London  
**Date:** 2018  
**ISBN:** 978-0128023082

## Using BCS Books

Accredited Training Organisations may include excerpts from BCS books in the course materials. If you wish to use excerpts from the books you will need a license from BCS. To request a license, please contact the Head of Publishing at BCS outlining the material you wish to copy and its intended use.

## Document Change History

Any changes made to the syllabus shall be clearly documented with a change history log. This shall include the latest version number, date of the amendment and changes made. The purpose is to identify quickly what changes have been made.

<b>Version Number</b>	<b>Changes Made</b>
<b>Version 1.0</b> <b>August 2021</b>	Document created

# CONTACT

For further information please contact:

## **BCS**

The Chartered Institute for IT  
3 Newbridge Square  
Swindon  
SN1 1BY

**T** +44 (0)1793 417 445

[www.bcs.org](http://www.bcs.org)

© 2021 Reserved. BCS, The Chartered Institute for IT

All rights reserved. No part of this material protected by this copyright may be reproduced or utilised in any form, or by any means, electronic or mechanical, including photocopying, recording, or by any information storage and retrieval system without prior authorisation and credit to BCS, The Chartered Institute for IT.

Although BCS, The Chartered Institute for IT has used reasonable endeavours in compiling the document it does not guarantee nor shall it be responsible for reliance upon the contents of the document and shall not be liable for any false, inaccurate or incomplete information. Any reliance placed upon the contents by the reader is at the reader's sole risk and BCS, The Chartered Institute for IT shall not be liable for any consequences of such reliance.

